# BAY AREA
# '91 CLEAN AIR PLAN

## VOLUME IV



## APPENDIX H
## SOURCE INVENTORY DESCRIPTION

**October 1991**

*Prepared by*
*Bay Area Air Quality Management District*
*in cooperation with*
*Metropolitan Transportation Commission and*
*Association of Bay Area Governments*

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# SOURCE INVENTORY DESCRIPTION

## BASE YEAR 1987 EMISSION INVENTORY

### BACKGROUND

An emission inventory is an itemized list of emission estimates for sources of air pollution in a given area, for a specified time period. Present and future year inventories are critical components of air quality planning and modeling. The ultimate goal of the planning process is to identify and achieve an emission pattern which does not result in exceedance of ambient standards.

The BAAQMD began preparing inventories in 1957. The current emission inventory to be used for planning and photochemical modeling is different from traditional inventory reports, which show annual average emissions by counties. For ozone planning, a typical summer day inventory is needed.

Photochemical modeling requires an inventory for each hour of the day with emission rates for pollutant species for each five kilometer grid square in the modeling domain. The volatile organic compound (VOC) emissions are disaggregated into eleven species of differing reactivity for ozone formation.

The inventory is divided into stationary (point, area, and biogenic) and mobile source emissions. Stationary source emissions are calculated by the BAAQMD using various procedures. Emission computation methodology by source categories is set forth in the BAAQMD publication "Source Category Methodologies." The BAAQMD participates in the California Emission Inventory Technical Advisory Committee (EITAC) and maintains the best available inventory methodologies.

#### Stationary Source Emissions

Point Sources. Sources identified on an individual facility or source basis are called point sources. Refineries and industrial plants are examples of point sources. The emission characteristics of individual facilities vary widely and each facility is examined individually. The Permit Services Division of the BAAQMD collects and maintains detailed information on point sources. Almost all facilities emitting greater than 2.5 tons/year of any air pollutants are included in the computer data bank. The 1987 base year inventory accounts for about 2,400 facilities, with 18,000 different sources. There are about 28,000 different processes, because some sources have more than one process. Examples are: boilers burning different fuels, tanks storing different materials, and painting/printing operations using different coatings.

The data on the activity, seasonal variations, and hours of operation are collected at the process level from each facility. Parameters which affect the quantity of emissions are updated regularly. Emissions are calculated using the detailed data for each of the 7,000 processes listed as storage of organic liquid, and 10,000 processes listed as organic solvent users. The emissions from the combustion and other general processes are computed using generalized or specific emission factors. These factors are periodically reviewed and updated. Detailed listings of sources, with their emissions, were sent for review to all facilities emitting greater than 10 tons/year of any pollutant. All major discrepancies noted by the facilities were reconciled and the corrections made in the data. The contribution of point sources to the 1987 emission inventory is shown by counties in Table I.

The data bank also contains the location coordinates of each facility for input to the photochemical model. Point source listings also carry source category labels for model input, future year projections, and control strategy experiments.

Area Sources. Those stationary sources which are not identified individually are called area sources. This term is sometimes extended to cover numerous small point sources such as dry cleaners or gas stations which are known (at least potentially) individually. It always includes the diverse, unpermitted small sources which individually do not emit significant amounts of pollutants but which together make an appreciable contribution to the emission inventory. Examples of area sources are residential heating and use of paints, varnishes, and consumer products. Emissions from these sources are grouped into categories and calculated based on surrogate variables. Information on these surrogates is usually available for the State or by county. Selected surrogates are used to apportion the category emissions into diurnal and spatial patterns for photochemical modeling. Emissions for some source categories are estimated by ARB based on statewide data.

Many area source categories are further classified into sub-categories for better emission computation, speciation, regulation development, and future year projections. For example, emissions from aircraft categories are subdivided into various aircraft types at each of the airports in the Bay Area. Architectural coating categories are subdivided into various types of coatings and varnishes to account for varying solvent content. There are more than 900 different sub-categories used in this inventory. Emissions for categories affected by regulations are adjusted to reflect the controls required and the estimated rule effectiveness achieved.

Biogenic Sources. In addition to man-made air pollution, there are significant quantities of pollutants from natural sources such as plants, animals, marshes, and the earth itself. Vegetation for example, emits large amounts of isoprene, terpenes, and other organic compounds which are precursors of ozone. Emission rates depend upon species, season, biomass density, time of day, local temperature, moisture and other factors. Total reactive organic emissions from Bay Area vegetation are about 300 tons per day.

## TABLE I.
## 1987 POINT SOURCE EMISSIONS BY COUNTIES

Tons/Day

| | PM | TOG | $NO_x$ | $SO_2$ | CO |
|---|---|---|---|---|---|
| Alameda | 5.6 | 18.9 | 11.1 | 2.0 | 2.2 |
| Contra Costa | 10.7 | 41.2 | 86.0 | 40.3 | 42.8 |
| Marin | .2 | .7 | .2 | - | - |
| Napa | 2.0 | .8 | 1.1 | - | .3 |
| San Francisco | .3 | 1.6 | 7.6 | .8 | 1.5 |
| San Mateo | 1.8 | 4.3 | .9 | .2 | 1.0 |
| Santa Clara | 2.7 | 17.7 | 15.4 | 1.1 | 8.2 |
| Solano | .9 | 5.9 | 9.5 | 15.3 | 1.6 |
| Sonoma | 1.5 | .7 | .3 | - | - |
| **District Total** | **26** | **92** | **132** | **60** | **58** |

PM - particulate matter
TOG - total organic gases
$NO_x$ - oxides of nitrogen, reported as $NO_2$
$SO_2$ - sulfur dioxide
CO - carbon monoxide

## TABLE II.
## NON-REACTIVE COMPOUNDS

1. Methane
2. Methylene chloride
3. Methyl Chloroform (1,1,1 Trichloroethane)
4. Trichlorotrifluoroethane (CFC-113)
5. Trichlorofluoromethane (CFC-111)
6. Dichlorodifluoromethane (CFC-12)
7. Chlorodifluoromethane (CFC-22)
8. Trifluoromethane (CFC-23)
9. Dichlorotetrafluoroethane (CFC-114)
10. Chloropentafluoroethane (CFC-115)

Mobile Source Emissions

Mobile sources consist of on-road motor vehicles and other sources, such as ships, aircraft, garden and construction equipment. Emissions from on-road motor vehicles are a major portion of the emissions inventory.

ARB uses EMFAC7E and BURDEN7C computer models for the development of the on-road motor vehicles emission inventory.

EMFAC7E calculates emission rates for a variety of vehicle types (passenger cars, trucks, etc), fuel usage, control technology and mode of operation. It also accounts for vehicle age, and operating conditions such as speed and temperature. Emission reductions resulting from the California's Inspection and Maintenance ("Smog Check") program are also incorporated.

BURDEN7C uses emission factors from EMFAC7E and a large data base of activity for each county to calculate total daily emissions. The activity is in the form of number of in-use vehicles, number of cold and hot starts and vehicle miles traveled (VMT) for each vehicle type. The activity data for these calculations are developed jointly by the California Department of Transportation (Caltrans) and ARB using travel models.

Various methodologies are used for compilation of the remaining mobile sources. Emission factors and methodologies for these sources are provided by ARB and EPA. Aircraft mix and activity data specific to each airport were used in estimating emissions at airports.

SUPPLEMENTAL DATA

In addition to emission data, supplemental data are collected to prepare spatial, temporal and chemically speciated, inventories. Disaggregated inventories are useful for photochemical modeling, sub-regional planning, and other specialized analyses.

Spatial

A rectangular coordinate system is used to define the location of sources. The Universal Transverse Mercator (UTM) coordinates for point sources are obtained as a part of the point source inventory procedures discussed above. The emissions can then be assigned to a grid cell, based upon the UTM coordinates. The grid is a map overlay that divides a region into squares of equal size, commonly 1, 2, 5 or 10 kilometers.

The Association of Bay Area Governments (ABAG) provides demographic data for the Bay Area. Examples are: population, housing units, employment and acres of agricultural land by grid square and by county. Area source emissions by source category for each county are then distributed to the grids using the above mentioned activity data as surrogates. For on-road motor vehicles, spatial distribution was based on MTC transportation model results. For some source categories, such as shipping and aircraft, supplemental activity data by grid cells are assembled to distribute emissions.

Temporal

Data on the normal operating schedules (hours per day, days per week, and seasonal variations) are collected as a part of routine point source inventory procedures. For area sources, representative profiles showing monthly, weekly, and daily variation in emissions are prepared for each source category. These profiles are then used to produce daily (weekday or weekend) hourly inventory by seasons. Specific-day emission data may be available and useful for some large sources. For motor vehicles, Caltran's Direct Travel Impact Model (DTIM) was used in conjunction with MTC data to generate gridded hourly emissions. The results were used primarily for photo-chemical modeling.

Organic Species

Organic species profiles show the fraction of various species of organic compounds and the reactivity class such as olefins, paraffins, and aromatics. These profiles are shown in ARB's publication "Identification of Volatile Organic Compound Species Profiles", dated July 1989. Representative organic species profiles are assigned to each source category in the inventory to obtain the emissions by species for the photochemical model. To show reactive organic compound (ROG) emissions only, the non-reactive organic compounds, listed in Table II are excluded from total organics (TOG).

UNCERTAINTY

One of the most frequently asked question regarding emission inventories is, "How well does this inventory quantify the total amount of pollutants being emitted to the atmosphere?" This is a difficult question to answer because emissions are influenced by many variables. Accurate measurements are available only for a relatively small selected sample of sources, under a fixed set of conditions at a specific location and time.

This inventory contains estimates of emissions for individual processes that could be identified and is based on the best data available at the time. Certainly not all estimated data are of the same quality. Estimates for a process are good when they are based on a material balance and accurate records have been kept of the materials involved. As an example, the emissions from a spray painting operation that has records for the amount of paint used, the solvent content of the paint and the amount of solvent used for thinning and cleaning, has a high degree of confidence.

Estimates are also accurate when records have been maintained of process thruput (process rate) and source tests have been conducted on the equipment over a wide range of operating conditions. This is typical of many power plant emission estimates where daily records of fuel use and boiler operation are maintained. Emission estimates are less accurate when process rate records are approximated and emissions factors are average values based on tests of similar units.

Emissions from some categories are based on consumer surveys, product sales records, and chemical formulation data. And, at any given time, some emissions are unreported and unknown. Individuals using the inventory should be aware of the fact that total emissions or category emission summaries may contain estimates of varying quality. New information to

improve inventory estimates is continually becoming available and will be used in subsequent year inventories as appropriate.

Given that the emissions in the inventory are not completely accurate, inventories are still useful and necessary for planning. Because laboratory smog chamber results are used to evaluate photochemical module performance, the modeling results provide one source of information to assess inventory validity. Every three years, new base and future year inventories will be prepared using the latest data and measuring techniques. Emission reduction targets may be derived from modeling runs with updated inventories.

Uncertainty Analysis

There are different techniques available to quantify the uncertainty in the emissions inventory. Because only a tiny fraction of emissions are measured directly, there is little data on which uncertainty estimates can be based. The exercise often takes on a Delphi sort of character, wherein experts use their best professional judgment to estimate the uncertainty by source category. Based on these estimates the overall uncertainty in the inventory can be developed. The sensitivity of the photochemical model can then be determined, over the range of emission uncertainty.

An additional source of inventory uncertainty, even more difficult to quantify, is the possible existence of unknown emission sources--manmade and natural. It seems appropriate to run the model with the best possible inventory and make adjustments in the photochemical model so that reasonable verification of the model is achieved. If time permits, uncertainty estimates will be attempted for all sources at the source category level for base and future years. These emission uncertainty bounds will be used to explore the uncertainty of modeling conclusions.

## PLANNING INVENTORY

An annual average inventory represents the emissions on an average day during a year. It is simply the total emissions in tons divided by 365 days. ARB has published guidelines for preparing planning Inventories to represent emission occurring during periods when ambient air quality standards are exceeded.

For ozone, the planning inventory estimates reactive organic gases and oxides of nitrogen emissions for a summer (week) day as appropriate for ozone episodes. The carbon monoxide inventory shows carbon monoxide emissions for a winter day, appropriate for CO attainment planning.

The emissions for this inventory are grouped in point, area, and motor vehicle categories. The point source emissions are based on "average annual operating day" during the year. Area source emissions are based on "average seasonal operating day". Motor vehicle emissions are based on "typical episodic day" emissions. Modified versions of EMFAC7E and BURDEN7C were developed by ARB for the generation of the planning inventory. The average diurnal temperature profile for a typical episodic day is based on the ten worst air quality days during the years 1986, 1987 and 1988 for summer and winter seasons. The emission factors for motor vehicles reflect temperature and activity data (vehicle miles traveled, speed, etc.) for six time periods: 00-05, 06-08, 09-11, 12-14, 15-17, and 18-23 where 00-05 represents midnight to 5:59 am). The summer season for ozone is from May through October. The winter season for carbon monoxide is November through April, but most episodes occur in December and January.

The base line ozone planning inventories for 1987, 1994, 1997 and 2000 are shown in Table III and Table IV by main source categories.

# TABLE III

## BAY AREA AIR QUALITY MANAGEMENT DISTRICT

### Planning Inventory

Base Year 1987

Tons/Day

| | 1987 | | | 1994 | | |
|---|---|---|---|---|---|---|
| | ROG | NOx | CO | ROG | NOx | CO |
| INDUSTRIAL/COMMERCIAL PROCESSES/FACILITIES | | | | | | |
| PETROLEUM REFINING FACILITIES | | | | | | |
| Basic Refining Processes | .1 | 10.8 | .1 | .1 | 11.9 | .1 |
| Wastewater (Oil-Water) Separators | 5.9 | -- | -- | 5.2 | -- | -- |
| Cooling Towers | 2.5 | -- | -- | 2.7 | -- | -- |
| Flares and Blowdown Systems | .2 | .2 | 1.6 | .3 | .2 | 1.7 |
| Other Refining Processes | .5 | -- | -- | .6 | -- | -- |
| Fugitives | 14.3 | -- | -- | 15.5 | -- | -- |
| Sub total | 24 | 11 | 2 | 24 | 12 | 2 |
| CHEMICAL MANUFACTURING FACILITIES | | | | | | |
| Sulfur | .1 | -- | .1 | .1 | -- | .1 |
| Coatings & Inks | 3.1 | -- | -- | 3.9 | -- | -- |
| Resins | .2 | -- | -- | .3 | -- | -- |
| Pharmaceuticals & Cosmetics | .4 | -- | -- | .4 | -- | -- |
| Other Chemicals Mfg. | .7 | 2.0 | 27.6 | .7 | 2.2 | 30.8 |
| Fugitives (all mfg.)- Valves & Flanges | .1 | -- | -- | .2 | -- | -- |
| Sub total | 5 | 2 | 28 | 5 | 2 | 31 |
| OTHER INDUSTRIAL/COMMERCIAL PROCESSES/FACILITIES | | | | | | |
| Bakeries | 1.6 | -- | -- | 1.1 | -- | -- |
| Cooking | 1.2 | -- | -- | 1.5 | -- | -- |
| Wineries | .8 | -- | -- | .8 | -- | -- |
| Other Food & Agricultural Processes | .2 | .1 | -- | .2 | .1 | -- |
| Metallurgical | 1.3 | .1 | .1 | 1.4 | .1 | .1 |
| Contaminated Soil Aeration | .8 | -- | -- | .1 | -- | -- |
| Semiconductor Manufacturing | 2.0 | -- | -- | 1.6 | -- | -- |
| Flexible & Rigid Discs Manufacturing | .8 | -- | -- | .2 | -- | -- |
| Fiberglass Products Manufacturing | .9 | -- | -- | .2 | -- | -- |
| Rubber Products Manufacturing | 1.6 | -- | -- | 2.2 | -- | -- |
| Plastic Products Manufacturing | .2 | -- | -- | .2 | -- | -- |
| Oil Production Fields | .1 | -- | -- | -- | -- | -- |
| Gas Production Fields | .4 | -- | -- | .1 | -- | -- |
| Waste Management | 9.2 | .2 | -- | 5.0 | .2 | -- |
| Other Industrial Commercial | 1.4 | .2 | .1 | 1.5 | .2 | .1 |
| Sub total | 22 | 1 | -- | 16 | 1 | -- |

Base Year 1987

| | Tons/Day | | | | | |
|---|---|---|---|---|---|---|
| | 1987 | | | 1994 | | |
| | ROG | NOx | CO | ROG | NOx | CO |
| PETROLEUM PRODUCT/SOLVENT EVAPORATION | | | | | | |
| PETROLEUM REFINERY EVAPORATION | | | | | | |
| Storage Tanks | 4.8 | -- | -- | 5.2 | -- | -- |
| Loading Operations | 5.0 | -- | -- | .5 | -- | -- |
| Sub total | 10 | -- | -- | 6 | -- | -- |
| FUELS DISTRIBUTION | | | | | | |
| Natural Gas Distribution | 2.3 | -- | -- | 2.6 | -- | -- |
| Bulk Plants | 1.0 | -- | -- | 1.0 | -- | -- |
| Loading Trucks | 2.1 | -- | -- | .9 | -- | -- |
| Trucking | .2 | -- | -- | .2 | -- | -- |
| Gasoline Filling Stations | 16.6 | -- | -- | 17.2 | -- | -- |
| Aircraft Fueling | 1.6 | -- | -- | 1.7 | -- | -- |
| Recreational Boat Fueling | .9 | -- | -- | .9 | -- | -- |
| Sub total | 25 | -- | -- | 25 | -- | -- |
| OTHER ORGANIC COMPOUNDS EVAPORATION | | | | | | |
| Storage Tanks | 1.5 | -- | -- | 1.7 | -- | -- |
| Lightering | 1.7 | -- | -- | .2 | -- | -- |
| Ballasting | 1.0 | -- | -- | 1.1 | -- | -- |
| Marine Vessel Cleaning & Gas Freeing | .4 | -- | -- | .4 | -- | -- |
| Sterilizers | .1 | -- | -- | .1 | -- | -- |
| Marine Loading (Non-Refinery) | 1.0 | -- | -- | -- | -- | -- |
| Asphalt Paving | 3.8 | -- | -- | .8 | -- | -- |
| Industrial Degreasing | 4.4 | -- | -- | 4.8 | -- | -- |
| Commercial Degreasing | 2.6 | -- | -- | 2.8 | -- | -- |
| Dry Cleaners | 5.6 | -- | -- | 6.1 | -- | -- |
| Printing | 6.7 | -- | -- | 7.0 | -- | -- |
| Adhesives & Sealants | 3.1 | -- | -- | 3.6 | -- | -- |
| Structures Coating | 39.7 | -- | -- | 32.9 | -- | -- |
| Industrial/Commercial Coating | 46.5 | -- | -- | 44.8 | -- | .1 |
| Other Organics Evaporation | 1.2 | -- | -- | 1.5 | -- | -- |
| Sub total | 119 | -- | -- | 108 | -- | -- |
| COMBUSTION - STATIONARY SOURCES | | | | | | |
| FUELS COMBUSTION | | | | | | |
| Domestic | 3.3 | 13.0 | 318 | 3.7 | 140 | 348 |
| Cogeneration | 1.6 | 11.9 | 3.6 | 1.9 | 13.8 | 4.2 |
| Power Plants | .2 | 32.4 | 8.1 | .1 | 13.5 | 3.5 |
| Oil Refineries External Combustion | .6 | 47.1 | 5.5 | .7 | 47.8 | 5.5 |
| Reciprocating Engines | .9 | 12.7 | 3.5 | 1.0 | 14.3 | 3.9 |
| Turbines | .2 | 2.2 | 1.1 | .4 | 2.2 | 1.2 |
| Other External Combustion | .5 | 28.4 | 11 | .6 | 33.4 | 12.8 |
| Sub total | 8 | 148 | 351 | 8 | 139 | 380 |

Base Year 1987

Tons/Day

| | 1987 | | | 1994 | | |
|---|---|---|---|---|---|---|
| | ROG | NOx | CO | ROG | NOx | CO |
| BURNING OF WASTE MATERIAL | | | | | | |
| Incineration | .7 | 1.2 | 1.6 | .8 | 1.3 | 1.7 |
| Planned Fires | -- | -- | .7 | .1 | -- | .9 |
| Sub total | 1 | 1 | 2 | 1 | 1 | 3 |
| COMBUSTION - MOBILE SOURCES | | | | | | |
| OFF-HIGHWAY MOBILE SOURCES | | | | | | |
| Lawn, Garden and Other Utility Equipment | 11.0 | .5 | 47.0 | 12.4 | .6 | 54.3 |
| Transportation Refrigeration Units | 1.0 | .9 | 15.6 | 1.0 | 1.0 | 17.0 |
| Farm Equipment | 1.9 | 7.9 | 7.5 | 2.2 | 9.2 | 8.8 |
| Heavy Duty Industrial/Construction Equipment | 20.7 | 87.5 | 180 | 22.7 | 92.1 | 212.0 |
| Light Duty Industrial/Construction Equipment | 5.5 | 10.3 | 32.0 | 6.4 | 11.6 | 37.5 |
| Locomotives | 1.3 | 5.5 | 1.9 | 1.4 | 5.7 | 2.0 |
| Off Road Motorcycles | 1.3 | -- | 1.4 | 1.4 | -- | 1.5 |
| Ships Maneuvering | .2 | .7 | .1 | .3 | .8 | .1 |
| Ships Berthing | .1 | .9 | .1 | .1 | 1.0 | .1 |
| Ships In-Transit | 1.0 | 3.4 | .6 | 1.2 | 3.9 | .7 |
| Commercial Boats | .5 | 1.0 | .8 | .6 | 1.2 | .9 |
| Recreational Boats | 19.0 | 4.9 | 74.9 | 20.9 | 5.4 | 82.5 |
| Sub total | 63 | 124 | 362 | 71 | 133 | 419 |
| AIRCRAFT | | | | | | |
| Commercial Aircraft | 5.4 | 11.0 | 15.6 | 6.3 | 12.9 | 18.3 |
| General Aviation | 2.7 | .6 | 29.4 | 3.3 | .7 | 35.3 |
| Military Aircraft | 8.6 | 4.0 | 14.2 | 8.6 | 4.0 | 14.2 |
| Agricultural Aircraft | -- | -- | .2 | -- | -- | .2 |
| Sub total | 17 | 16 | 59 | 18 | 18 | 68 |
| ON ROAD MOTOR VEHICLES | | | | | | |
| Light Duty Passenger | 234.1 | 195.0 | 2197.0 | 112 | 115.6 | 1621.0 |
| Light And Medium Duty Trucks | 65.1 | 61.7 | 558.0 | 35.5 | 44.5 | 455.0 |
| Heavy Duty Trucks | 22.5 | 95.0 | 243.0 | 15.0 | 80.4 | 153.0 |
| Heavy Duty Buses | 1.1 | 1.0 | 3.9 | 1.0 | 6.4 | 4.5 |
| Motorcycles-Non Catalytic | 4.3 | 8.2 | 14.4 | 3.4 | 1.3 | 15.7 |
| Sub total | 327 | 361 | 3017 | 167 | 248 | 2249 |
| MISCELLANEOUS OTHER SOURCES | | | | | | |
| Accidental Fires | .2 | -- | 4.0 | .2 | -- | 4.4 |
| Agricultural Pesticides | 2.6 | -- | -- | 2.8 | -- | -- |
| Non-Agricultural Pesticides | 4.8 | -- | -- | 5.0 | -- | -- |
| Consumer Products (no pesticides) | 48.4 | -- | -- | 42.8 | -- | -- |
| Sub total | 57 | -- | 4.0 | 51 | -- | 4.4 |
| BANKING | -- | -- | -- | 8.0 | 7.0 | 6.0 |
| GRAND TOTAL | 677 | 662 | 3830 | 507 | 560 | 3160 |

# TABLE IV

# BAY AREA AIR QUALITY MANAGEMENT DISTRICT

## Planning Inventory

Base Year 1987

Tons/Day

| | 1997 | | | 2000 | | |
|---|---|---|---|---|---|---|
| | ROG | NOx | Co | ROG | NOx | Co |
| INDUSTRIAL/COMMERCIAL PROCESSES/FACILITIES | | | | | | |
| PETROLEUM REFINING FACILITIES | | | | | | |
| Basic Refining Processes | .1 | 12.1 | .1 | .1 | 12.4 | .1 |
| Wastewater (Oil-Water) Separators | 5.3 | -- | -- | 5.5 | -- | -- |
| Cooling Towers | 2.8 | -- | -- | 2.9 | -- | -- |
| Flares and Blowdown Systems | .3 | .2 | 1.8 | .3 | .2 | 1.8 |
| Other Refining Processes | .6 | -- | -- | .6 | -- | -- |
| Fugitives | 16.0 | -- | -- | 16.5 | -- | -- |
| Sub total | 25.1 | 12.3 | 1.9 | 25.8 | 12.6 | 2.0 |
| CHEMICAL MANUFACTURING FACILITIES | | | | | | |
| Sulfur | .1 | -- | .1 | .1 | -- | .1 |
| Coatings & Inks | 4.2 | -- | -- | 4.3 | -- | -- |
| Resins | .3 | -- | -- | .3 | -- | -- |
| Pharmaceuticals & Cosmetics | .4 | -- | -- | .4 | -- | -- |
| Other Chemicals Mfg. | .8 | 2.3 | 32.6 | .8 | 2.5 | 34.4 |
| Fugitives (all mfg.)- Valves & Flanges | .2 | -- | -- | .2 | -- | -- |
| Sub total | 5.9 | 2.4 | 32.7 | 6.1 | 2.5 | 34.5 |
| OTHER INDUSTRIAL/COMMERCIAL PROCESSES/FACILITIES | | | | | | |
| Bakeries | 1.1 | -- | -- | 1.1 | -- | -- |
| Cooking | 1.6 | -- | -- | 1.8 | -- | -- |
| Wineries | .8 | -- | -- | .9 | -- | -- |
| Other Food & Agricultural Processes | .3 | .1 | -- | .3 | .1 | -- |
| Metallurgical | 1.4 | .1 | .1 | 1.5 | .1 | .1 |
| Contaminated Soil Aeration | .1 | -- | -- | .1 | -- | -- |
| Semiconductor Manufacturing | 1.7 | -- | -- | 1.8 | -- | -- |
| Flexible & Rigid Discs Manufacturing | .2 | -- | -- | .2 | -- | -- |
| Fiberglass Products Manufacturing | .2 | -- | -- | .2 | -- | -- |
| Rubber Products Manufacturing | 2.4 | -- | -- | 2.5 | -- | -- |
| Plastic Products Manufacturing | .3 | -- | -- | .3 | -- | -- |
| Oil Production Fields | -- | -- | -- | -- | -- | -- |
| Gas Production Fields | .1 | -- | -- | .1 | -- | -- |
| Waste Management | 4.9 | .2 | -- | 4.9 | .2 | -- |
| Other Industrial Commercial | 1.6 | .2 | .1 | 1.7 | .2 | .1 |
| Sub total | 16.8 | .5 | .2 | 17.3 | .6 | .3 |

Base Year 1987

Tons/Day

| | 1997 | | | 2000 | | |
|---|---|---|---|---|---|---|
| | ROG | NOx | Co | ROG | NOx | Co |
| PETROLEUM PRODUCT/SOLVENT EVAPORATION | | | | | | |
| PETROLEUM REFINERY EVAPORATION | | | | | | |
| Storage Tanks | 5.3 | -- | -- | 5.5 | -- | -- |
| Loading Operations | .4 | -- | -- | .5 | -- | -- |
| Sub total | 5.8 | -- | -- | 6.0 | -- | -- |
| FUELS DISTRIBUTION | | | | | | |
| Natural Gas Distribution | 2.7 | -- | -- | 2.9 | -- | -- |
| Bulk Plants | 1.0 | -- | -- | 1.0 | -- | -- |
| Loading Trucks | .9 | -- | -- | .9 | -- | -- |
| Trucking | .2 | -- | -- | .2 | -- | -- |
| Gasoline Filling Stations | 17.3 | -- | -- | 17.5 | -- | -- |
| Aircraft Fueling | 1.7 | -- | -- | 1.8 | -- | -- |
| Recreational Boat Fueling | .8 | -- | -- | .9 | -- | -- |
| Ships & Tugboats Fueling | -- | -- | -- | -- | -- | -- |
| Ferry & Fishing Boats Fueling | -- | -- | -- | -- | -- | -- |
| Sub total | 24.6 | -- | -- | 25.1 | -- | -- |
| OTHER ORGANIC COMPOUNDS EVAPORATION | | | | | | |
| Storage Tanks | 1.8 | -- | -- | 1.9 | -- | -- |
| Lightering | .2 | -- | -- | .2 | -- | -- |
| Ballasting | 1.1 | -- | -- | 1.2 | -- | -- |
| Marine Vessel Cleaning & Gas Freeing | .4 | -- | -- | .5 | -- | -- |
| Sterilizers | .1 | -- | -- | .1 | -- | -- |
| Marine Loading (Non-Refinery) | -- | -- | -- | -- | -- | -- |
| Asphalt Paving | .9 | -- | -- | .9 | -- | -- |
| Industrial Degreasing | 5.0 | -- | -- | 5.1 | -- | -- |
| Commercial Degreasing | 2.9 | -- | -- | 3.0 | -- | -- |
| Dry Cleaners | 6.3 | -- | -- | 6.5 | -- | -- |
| Printing | 7.6 | -- | -- | 7.9 | -- | -- |
| Adhesives & Sealants | 3.8 | -- | -- | 4.0 | -- | -- |
| Structures Coating | 33.8 | -- | -- | 34.5 | -- | -- |
| Industrial/Commercial Coating | 47.3 | -- | -- | 49.1 | -- | -- |
| Other Organics Evaporation | 1.6 | -- | -- | 1.6 | -- | -- |
| Sub total | 113 | -- | -- | 116 | -- | -- |
| COMBUSTION - STATIONARY SOURCES | | | | | | |
| FUELS COMBUSTION | | | | | | |
| Domestic | 4.0 | 14.4 | 360 | 4.1 | 14.8 | 370 |
| Cogeneration | 2.0 | 14.6 | 4.5 | 2.1 | 15.4 | 4.7 |
| Power Plants | .1 | 15.0 | 3.9 | .1 | 17.9 | 4.6 |
| Oil Refineries External Combustion | .6 | 48.1 | 5.6 | .7 | 48.4 | 5.6 |
| Reciprocating Engines | 1.0 | 14.9 | 4.1 | 1.1 | 15.6 | 4.3 |
| Turbines | .2 | 2.2 | 1.2 | .2 | 2.3 | 1.2 |
| Other External Combustion | .6 | 35.7 | 13.7 | .7 | 37.9 | 14.6 |
| Sub total | 8.7 | 145 | 392 | 9.0 | 152 | 405 |

Base Year 1987

Tons/Day

| | 1997 | | | 2000 | | |
|---|---|---|---|---|---|---|
| | ROG | NOx | Co | ROG | NOx | Co |
| BURNING OF WASTE MATERIAL | | | | | | |
| Resource Recovery Projects | .3 | 6.0 | 6.6 | .3 | 6.0 | 6.6 |
| Incineration | .8 | 1.3 | 1.8 | .8 | 1.3 | 1.8 |
| Planned Fires | .1 | -- | .9 | .1 | -- | .9 |
| Sub total | 1.1 | 7.3 | 9.2 | 1.2 | 7.3 | 9.3 |
| COMBUSTION - MOBILE SOURCES | | | | | | |
| OFF-HIGHWAY MOBILE SOURCES | | | | | | |
| Lawn, Garden and Other Utility Equipment | 8.5 | .6 | 57.5 | 6.7 | .7 | 60.6 |
| Transportation Refrigeration Units | 1.1 | 1.0 | 17.7 | 1.1 | 1.0 | 18.2 |
| Farm Equipment | 2.4 | 9.8 | 9.0 | 2.5 | 10.2 | 9.4 |
| Heavy Duty Indust./Construction Equip. | 23.9 | 96.1 | 227 | 24.7 | 98.7 | 237 |
| Light Duty Indust./Construction Equip. | 6.8 | 12.3 | 39.9 | 7.0 | 12.7 | 41.7 |
| Locomotives | 1.5 | 6.2 | 2.1 | 1.5 | 6.3 | 2.2 |
| Off Road Motorcycles | 1.5 | -- | 1.5 | 1.5 | -- | 1.6 |
| Four-wheel Drive Vehicles | .3 | .1 | 1.4 | .3 | .2 | 1.4 |
| Ships Maneuvering | .3 | .8 | .2 | .3 | .8 | .2 |
| Ships Berthing | .1 | 1.0 | .2 | .1 | 1.1 | .2 |
| Ships In-Transit | 1.2 | 4.1 | .7 | 1.3 | 4.2 | .8 |
| Commercial Boats | .6 | 1.3 | .9 | .6 | 1.3 | 1.0 |
| Recreational Boats | 21.6 | 5.5 | 85.2 | 22.2 | 5.7 | 87.8 |
| Sub total | 69.7 | 139 | 443 | 69.9 | 143 | 462 |
| AIRCRAFT | | | | | | |
| Commercial Aircraft | 6.7 | 13.6 | 19.4 | 6.9 | 14.1 | 20.0 |
| General Aviation | 3.5 | .8 | 37.5 | 3.6 | .8 | 39.0 |
| Military Aircraft | 8.6 | 4.0 | 14.2 | 8.6 | 4.0 | 14.2 |
| Agricultural Aircraft | -- | -- | .2 | -- | -- | .2 |
| Sub total | 18.7 | 18.4 | 71.4 | 19.0 | 18.9 | 73.5 |
| ON ROAD MOTOR VEHICLES | | | | | | |
| Light Duty Passenger | 89.8 | 95.3 | 1395 | 69.1 | 78.9 | 1214 |
| Light And Medium Duty Trucks | 29.2 | 41.1 | 397 | 22.9 | 38.7 | 347 |
| Heavy Duty Trucks | 13.9 | 78.7 | 126 | 13.3 | 77.4 | 106 |
| Heavy Duty Buses | 1.0 | 5.7 | 4.6 | 1.0 | 5.8 | 4.8 |
| Motorcycles-Non Catalytic | 3.6 | 1.2 | 16.7 | 3.9 | 1.3 | 17.6 |
| Sub total | 137 | 222 | 1939 | 110 | 202 | 1689 |
| MISCELLANEOUS OTHER SOURCES | | | | | | |
| Accidental Fires | .2 | .1 | 4.5 | .3 | .1 | 4.6 |
| Creosote Application | .5 | -- | -- | .5 | -- | -- |
| Agricultural Pesticides | 2.8 | -- | -- | 2.8 | -- | -- |
| Non-Agricultural Pesticides | 5.0 | -- | -- | 5.1 | -- | -- |
| Consumer Products (no pesticides) | 44.0 | -- | -- | 44.0 | -- | -- |
| Sub total | 52.6 | .1 | 4.5 | 52.7 | .1 | 4.6 |
| BANKING | 8.0 | 7.0 | 6.0 | 8.0 | 7.0 | 6.0 |
| GRAND TOTAL | 487 | 554 | 2900 | 467 | 546 | 2690 |

## FUTURE PROJECTIONS OF BASELINE EMISSION INVENTORY

### BACKGROUND

Baseline emission inventory projections for future years are essential for evaluating the impact of proposed control measures. Future baseline emissions are forecast from the base year (1987) emission inventory by utilizing projected growth rates and calculating the year-by-year effectiveness of already-adopted control measures. The estimated emissions for 1987, 1994, 1997, 2000 and 2010 are shown in Tables V through IX respectively. In these tables, emissions from all known sources are shown by major source categories for the following six pollutants:

| | |
|---|---|
| Particulate Matter | PM |
| Total Organics | TOG |
| Reactive Organics | ROG |
| Oxides of Nitrogen | $NO_x$ |
| Sulfur Dioxide | $SO_2$ |
| Carbon Monoxide | CO |

All the emissions data are given in tons/day, for an average day annual, obtained by dividing the total annual emissions of an air contaminant by 365. Annual average inventories may be converted to seasonal or day-specific versions for specialized planning or modeling needs.

### ESTIMATION OF FUTURE EMISSIONS

Baseline future year emissions for each source category are calculated from the base year (1987) emissions using the following equation:

$$Em_{FY} = EM_{BY} \times CF \times GF$$

where $(EM)_{FY}$ in the forecasted emissions of an air pollutant for any future year. $(EM)_{BY}$ represent the base year emissions of the air pollutant (1987 is the base year in this forecast). The control factor CF is an indicator for the level of control imposed as a result of currently existing State and Local air quality regulations. GF is a growth factor, derived from best available data for the different source categories. CF and GF are 1.0 for the base year 1987.

## TABLE V. SUMMARY OF BASELINE EMISSIONS BY MAJOR SOURCE CATEGORIES

### 1987 Emission Inventory

(Average Annual Day - Tons per Day)

**Base Year 1987**

| SOURCE CATEGORY | PM | TOG | ROG | NOx | SO2 | CO |
|---|---|---|---|---|---|---|
| INDUSTRIAL/COMMERCIAL PROCESSES/FACILITIES | | | | | | |
| PETROLEUM REFINING FACILITIES | 2.4 | 27.7 | 22.4 | 10.7 | 38.3 | 1.7 |
| CHEMICAL MANUFACTURING FACILITIES | 1.1 | 3.9 | 2.9 | 2.0 | 6.6 | 27.7 |
| OTHER INDUSTRIAL/COMMERCIAL PROCESSES/FACILITIES | 33.1 | 659 | 20.6 | .4 | 1.7 | .2 |
| Sub total | 36.6 | 690 | 45.9 | 13.2 | 46.6 | 29.6 |
| PETROLEUM PRODUCT/SOLVENT EVAPORATION | | | | | | |
| PETROLEUM REFINERY EVAPORATION | -- | 9.7 | 9.5 | -- | -- | -- |
| FUELS DISTRIBUTION | -- | 65.3 | 24.3 | -- | -- | -- |
| OTHER ORGANIC COMPOUNDS EVAPORATION | -- | 115 | 109 | -- | -- | -- |
| Sub total | -- | 190 | 142 | -- | -- | -- |
| COMBUSTION - STATIONARY SOURCES | | | | | | |
| FUELS COMBUSTION | 33.6 | 41.9 | 19.7 | 148 | 13.5 | 209 |
| BURNING OF WASTE MATERIAL | 1.0 | .8 | .6 | .9 | .3 | 2.7 |
| Sub total | 34.6 | 42.7 | 20.3 | 149 | 13.9 | 212 |
| COMBUSTION - MOBILE SOURCES | | | | | | |
| OFF-HIGHWAY MOBILE SOURCES | 5.5 | 46.1 | 44.1 | 77.8 | 21.3 | 388 |
| AIRCRAFT | 2.6 | 17.8 | 15.9 | 15.2 | .6 | 70.3 |
| ON ROAD MOTOR VEHICLES | 47.6 | 301 | 278 | 343 | 27.1 | 2022 |
| Sub total | 55.7 | 365 | 338 | 436 | 49.0 | 2481 |
| MISCELLANEOUS OTHER SOURCES | 823 | 403 | 351 | .1 | -- | 6.7 |
| Grand total - | 950 | 1691 | 897 | 599 | 109 | 2729 |

## TABLE VI. SUMMARY OF BASELINE EMISSIONS BY MAJOR SOURCE CATEGORIES

### 1994 Projected Emission Inventory

(Average Annual Day - Tons per Day)

**Base Year 1987**

| SOURCE CATEGORY | PM | TOG | ROG | NOx | SO2 | CO |
|---|---|---|---|---|---|---|
| INDUSTRIAL/COMMERCIAL PROCESSES/FACILITIES | | | | | | |
| PETROLEUM REFINING FACILITIES | 2.6 | 28.9 | 23.0 | 11.7 | 41.7 | 1.8 |
| CHEMICAL MANUFACTURING FACILITIES | 1.3 | 4.6 | 3.4 | 2.2 | 7.3 | 30.9 |
| OTHER INDUSTRIAL/COMMERCIAL PROCESSES/FACILITIES | 37.8 | 353 | 14.8 | .5 | 2.1 | .2 |
| Sub total | 41.7 | 386 | 41.3 | 14.4 | 51.2 | 32.9 |
| PETROLEUM PRODUCT/SOLVENT EVAPORATION | | | | | | |
| PETROLEUM REFINERY EVAPORATION | -- | 5.6 | 5.6 | -- | -- | -- |
| FUELS DISTRIBUTION | -- | 71.3 | 24.5 | -- | -- | -- |
| OTHER ORGANIC COMPOUNDS EVAPORATION | -- | 106 | 98.6 | -- | -- | -- |
| Sub total | -- | 183 | 129 | -- | -- | -- |
| COMBUSTION - STATIONARY SOURCES | | | | | | |
| FUELS COMBUSTION | 36.1 | 46.0 | 21.6 | 140 | 12.2 | 225 |
| BURNING OF WASTE MATERIAL | 1.1 | .9 | .7 | 1.0 | .3 | 3.0 |
| Sub total | 37.2 | 46.9 | 22.3 | 141 | 12.5 | 228 |
| COMBUSTION - MOBILE SOURCES | | | | | | |
| OFF-HIGHWAY MOBILE SOURCES | 6.0 | 51.5 | 49.3 | 84.0 | 24.5 | 449 |
| AIRCRAFT | 2.6 | 19.2 | 17.2 | 17.0 | .6 | 80.4 |
| ON ROAD MOTOR VEHICLES | 45.6 | 178 | 162 | 245 | 26.5 | 1370 |
| Sub total | 54.1 | 248 | 229 | 346 | 51.6 | 1900 |
| MISCELLANEOUS OTHER SOURCES | 957 | 409 | 350 | .7 | -- | 50.5 |
| Grand total - | 1090 | 1273 | 771 | 502 | 115 | 2211 |

## TABLE VII. SUMMARY OF BASELINE EMISSIONS BY MAJOR SOURCE CATEGORIES

### 1997 Projected Emission Inventory

(Average Annual Day - Tons per Day)

**Base Year 1987**

| SOURCE CATEGORY | PM | TOG | ROG | NOx | SO2 | CO |
|---|---|---|---|---|---|---|
| INDUSTRIAL/COMMERCIAL PROCESSES/FACILITIES | | | | | | |
| PETROLEUM REFINING FACILITIES | 2.6 | 29.7 | 23.7 | 12.0 | 43.0 | 1.9 |
| CHEMICAL MANUFACTURING FACILITIES | 1.3 | 4.9 | 3.7 | 2.4 | 7.8 | 32.7 |
| OTHER INDUSTRIAL/COMMERCIAL PROCESSES/FACILITIES | 40.5 | 354 | 15.5 | .5 | 2.3 | .2 |
| Sub total | 44.5 | 388 | 42.9 | 14.9 | 53.1 | 34.8 |
| PETROLEUM PRODUCT/SOLVENT EVAPORATION | | | | | | |
| PETROLEUM REFINERY EVAPORATION | -- | 5.8 | 5.8 | -- | -- | -- |
| FUELS DISTRIBUTION | -- | 73.8 | 24.7 | -- | -- | -- |
| OTHER ORGANIC COMPOUNDS EVAPORATION | -- | 110 | 103 | -- | -- | -- |
| Sub total | -- | 190 | 134 | -- | -- | -- |
| COMBUSTION - STATIONARY SOURCES | | | | | | |
| FUELS COMBUSTION | 37.2 | 47.6 | 22.3 | 147 | 12.6 | 232 |
| BURNING OF WASTE MATERIAL | 1.5 | 1.3 | 1.0 | 7.0 | 1.5 | 9.7 |
| Sub total | 38.7 | 48.9 | 23.3 | 153 | 14.1 | 242 |
| COMBUSTION - MOBILE SOURCES | | | | | | |
| OFF-HIGHWAY MOBILE SOURCES | 6.2 | 50.4 | 48.3 | 87.8 | 26.0 | 475 |
| AIRCRAFT | 2.6 | 19.9 | 17.8 | 17.9 | .6 | 85.1 |
| ON ROAD MOTOR VEHICLES | 45.8 | 150 | 137 | 222 | 12.6 | 1134 |
| Sub total | 54.6 | 220 | 203 | 328 | 39.2 | 694 |
| MISCELLANEOUS OTHER SOURCES | 1007 | 413 | 353 | .7 | -- | 50.6 |
| Grand total - | 1145 | 1260 | 755 | 497 | 106 | 2022 |

## TABLE VIII. SUMMARY OF BASELINE EMISSIONS BY MAJOR SOURCE CATEGORIES

### 2000 Projected Emission Inventory

(Average Annual Day - Tons per Day)

**Base Year 1987**

| SOURCE CATEGORY | PM | TOG | ROG | NOx | SO2 | CO |
|---|---|---|---|---|---|---|
| INDUSTRIAL/COMMERCIAL PROCESSES/FACILITIES | | | | | | |
| PETROLEUM REFINING FACILITIES | 2.7 | 30.6 | 24.4 | 12.4 | 44.2 | 2.0 |
| CHEMICAL MANUFACTURING FACILITIES | 1.4 | 5.1 | 3.8 | 2.5 | 8.2 | 34.5 |
| OTHER INDUSTRIAL/COMMERCIAL PROCESSES/FACILITIES | 42.8 | 353 | 16.0 | .5 | 2.4 | .2 |
| Sub total | 47.0 | 389 | 44.2 | 15.4 | 54.8 | 36.7 |
| PETROLEUM PRODUCT/SOLVENT EVAPORATION | | | | | | |
| PETROLEUM REFINERY EVAPORATION | -- | 6.0 | 5.9 | -- | -- | -- |
| FUELS DISTRIBUTION | -- | 76.4 | 25.1 | -- | -- | -- |
| OTHER ORGANIC COMPOUNDS EVAPORATION | -- | 114 | 106 | -- | -- | -- |
| Sub total | -- | 196 | 137 | -- | -- | -- |
| COMBUSTION - STATIONARY SOURCES | | | | | | |
| FUELS COMBUSTION | 38.3 | 49.2 | 23.1 | 154 | 13.0 | 240 |
| BURNING OF WASTE MATERIAL | 1.5 | 1.3 | 1.0 | 7.0 | 1.5 | 9.8 |
| Sub total | 39.8 | 50.5 | 24.0 | 161 | 14.5 | 250 |
| COMBUSTION - MOBILE SOURCES | | | | | | |
| OFF-HIGHWAY MOBILE SOURCES | 6.5 | 50.4 | 48.4 | 90.4 | 26.9 | 495 |
| AIRCRAFT | 2.6 | 20.2 | 18.1 | 18.3 | .6 | 87.8 |
| ON ROAD MOTOR VEHICLES | 46.2 | 134 | 122 | 213 | 12.3 | 947 |
| Sub total | 55.2 | 204 | 189 | 322 | 39.8 | 1530 |
| MISCELLANEOUS OTHER SOURCES | 1053 | 417 | 354 | .7 | -- | 50.8 |
| Grand total - | 1195 | 1256 | 748 | 499 | 109 | 1867 |

## TABLE IX. SUMMARY OF BASELINE EMISSIONS BY MAJOR SOURCE CATEGORIES

### 2010 Projected Emission Inventory

(Average Annual Day - Tons per Day)

**Base Year 1987**

| SOURCE CATEGORY | PM | TOG | ROG | NOx | SO2 | CO |
|---|---|---|---|---|---|---|
| INDUSTRIAL/COMMERCIAL PROCESSES/FACILITIES | | | | | | |
| PETROLEUM REFINING FACILITIES | 2.9 | 32.5 | 26.0 | 13.2 | 47.0 | 2.1 |
| CHEMICAL MANUFACTURING FACILITIES | 1.6 | 5.7 | 4.3 | 2.8 | 9.2 | 38.8 |
| OTHER INDUSTRIAL/COMMERCIAL PROCESSES/FACILITIES | 51.8 | 338 | 17.3 | .6 | 2.63 | |
| Sub total | 56.3 | 376 | 47.6 | 16.6 | 58.9 | 41.2 |
| PETROLEUM PRODUCT/SOLVENT EVAPORATION | | | | | | |
| PETROLEUM REFINERY EVAPORATION | -- | 6.3 | 6.3 | -- | -- | -- |
| FUELS DISTRIBUTION | -- | 84.2 | 26.6 | -- | -- | -- |
| OTHER ORGANIC COMPOUNDS EVAPORATION | -- | 125 | 117 | -- | -- | -- |
| Sub total | - | 215 | 150 | -- | -- | -- |
| COMBUSTION - STATIONARY SOURCES | | | | | | |
| FUELS COMBUSTION | 40.9 | 53.1 | 24.9 | 168 | 14.2 | 258 |
| BURNING OF WASTE MATERIAL | 1.9 | 1.7 | 1.3 | 13.0 | 2.7 | 16.7 |
| Sub total | 42.8 | 54.8 | 26.2 | 181 | 16.9 | 275 |
| COMBUSTION - MOBILE SOURCES | | | | | | |
| OFF-HIGHWAY MOBILE SOURCES | 7.1 | 51.7 | 49.8 | 99.6 | 29.9 | 553 |
| AIRCRAFT | 2.6 | 21.5 | 19.3 | 20.1 | .7 | 97.4 |
| ON ROAD MOTOR VEHICLES | 49.0 | 123 | 113 | 219 | 12.5 | 656 |
| Sub total | 58.7 | 197 | 183 | 338 | 43.1 | 307 |
| MISCELLANEOUS OTHER SOURCES | 1173 | 432 | 361 | .7 | -- | 51.1 |
| Grand total - | 1331 | 1275 | 767 | 537 | 119 | 1673 |

Control Factors

The impact of all adopted air pollution control rules are included in emission forecasts by means of control factors. For an individual source category, a future year control factor CF is calculated by the equation

$$CF_{FY} = \frac{E_{BY} - R}{E_{BY}}$$

where $E_{BY}$ is the base year 1987 emissions for a category affected by one or more of the air quality rules and R is the sum of emission reductions from the applicable rules. Thus the CF is unity for 1987 and less than one for years after 1987, if there are reductions from the rules. The control factors in this inventory take into account all State and Local air quality regulations in effect prior to Feb 1, 1991. The calculated control factors are shown in Table X, for organic emissions, by rules and by years.

Growth Factors

The baseline forecasts from the year 1987 to the years 1994, 1997, 2000 and 2010 for population, housing and other categories, are shown in Table XI. The data were obtained from the Association of Bay Area Governments (ABAG) and the California Air Resources Board (ARB). The motor vehicles growth rates for the year 2000 are shown separately in Table XII by vehicle type by county.

FUTURE BASELINE EMISSIONS

Total baseline emissions for the years 1989, 1994, 1997, 2000, and 2010 are shown below:

Total Emissions in the Bay Area Air Basin
(Tons per Average day)

| Pollutant | 1987 | 1994 | 1997 | 2000 | 2010 |
|---|---|---|---|---|---|
| PM | 950 | 1090 | 1145 | 1195 | 1331 |
| ROG | 897 | 771 | 755 | 748 | 767 |
| $NO_x$ | 599 | 502 | 497 | 499 | 537 |
| $SO_2$ | 109 | 115 | 106 | 109 | 119 |
| CO | 2729 | 2211 | 2022 | 1867 | 1673 |

## TABLE X. REGULATIONS AFFECTING ORGANIC EMISSIONS AND THE CONTROL FACTORS

### BASE YEAR 1987 INVENTORY

| Rule Number/Rule Title | Control Factors (C.F.) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1987 | 1989 | 1991 | 1993 | 1995 | 1997 | 1999 | 2010 |
| 3 Architectural Coatings | 1.00 | .88 | .86 | .81 | .81 | .81 | .81 | .81 |
| 4 General Solvent and Surface Coating Operations | 1.00 | .99 | .92 | .90 | .90 | .90 | .90 | .90 |
| 5 Storage of Organic Liquids | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 6 Terminals and Bulk Plants | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 7 Gasoline Dispensing Facilities | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 9 Vacuum Producing Systems | 1.00 | 1.00 | .97 | .97 | .97 | .97 | .97 | .97 |
| 11 Metal Container, Closure and Coil Coating | 1.00 | .95 | .93 | .93 | .93 | .93 | .93 | .93 |
| 12 Paper, Fabric and Film Coating | 1.00 | 1.00 | .93 | .93 | .93 | .93 | .93 | .93 |
| 13 Light and Medium Duty Motor Vehicle Assembly Plants | 1.00 | .99 | .88 | .87 | .86 | .86 | .86 | .86 |
| 14 Surface Coating of Large Appliance & Metal Furniture | 1.00 | .96 | .91 | .91 | .91 | .91 | .91 | .91 |
| 15 Emulsified and Liquid Asphalts | 1.00 | .18 | .18 | .18 | .18 | .18 | .18 | .18 |
| 16 Solvent Cleaning Operations | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 17 Petroleum Dry Cleaning Operations | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 19 Surface Coating of Miscelaneous Metal Parts & Products | 1.00 | 1.00 | .98 | .91 | .91 | .91 | .91 | .91 |
| 20 Graphic Arts Printing and Coating Operations | 1.00 | 1.00 | .85 | .85 | .85 | .85 | .85 | .85 |
| 22 Valves and Flanges at Chemical Plants | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 23 Coating of Flat Wood Paneling | 1.00 | .99 | .88 | .86 | .86 | .86 | .86 | .86 |
| 24 Pharmaceutical & Cosmsetic Manufacturing Operations | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 26 Magnet Wire Coating Operations | 1.00 | .99 | .88 | .86 | .86 | .86 | .86 | .86 |
| 27 Perchloroethylene Dry Cleaning Operations | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 29 Aerospace Assembly & Component Coating Operations | 1.00 | .99 | .88 | .86 | .86 | .86 | .86 | .86 |
| 32 Wood Furniture and Cabinet Coatings | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 34 Solid Waste Disposal Sites | 1.00 | .67 | .50 | .49 | .48 | .47 | .46 | .43 |
| 35 Coatings and Ink Manufacturing | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 37 Nat. Gas & Crude Oil Production Facilities | 1.00 | .28 | .28 | .28 | .28 | .28 | .28 | .28 |
| 38 Flexible and Rigid Disc Manufacturing | 1.00 | .32 | .19 | .19 | .19 | .19 | .19 | .19 |
| 40 Aeration of Contmnted Soil/Rmval of Undrgrnd Strge Tks. | 1.00 | 1.00 | 1.00 | .99 | .99 | .99 | .99 | .99 |
| 42 Large Commercial Bread Bakeries | 1.00 | .72 | .72 | .58 | .58 | .58 | .58 | .58 |
| 43 Surface Coating of Marine Vessels | 1.00 | 1.00 | .77 | .71 | .65 | .65 | .65 | .65 |
| 44 Marine Vessel Loading Terminals | 1.00 | 1.00 | .72 | .03 | .03 | .03 | .03 | .03 |
| 45 Motor Vehicle & Mobile Eauipment Coating Operations | 1.00 | 1.00 | .92 | .69 | .59 | .59 | .59 | .59 |
| 46 Marine Tank Vessel to Marine Tank Vessel Loading | 1.00 | 1.00 | .90 | .05 | .05 | .05 | .05 | .05 |
| 48 Industrial Maintenance Coatings | 1.00 | .90 | .84 | .78 | .78 | .78 | .78 | .78 |
| 49 Aerosol Paint Coatings | 1.00 | 1.00 | .96 | .88 | .85 | .84 | .81 | .81 |
| ** Utility Engines (ARB Rule) | 1.00 | 1.00 | 1.00 | 1.00 | .87 | .64 | .53 | .18 |
| ** Consumer Products (ARB Rule) | 1.00 | 1.00 | .98 | .85 | .81 | .81 | .79 | .79 |
| OVERALL CONTROL FACTOR | 1.00 | .95 | .90 | .83 | .82 | .81 | .80 | .79 |

** ARB Regulations

## TABLE XI. REGIONAL GROWTH FACTORS

| Description | | 1987 | 1990 | 1992 | 1994 | 1996 | 1998 | 2000 | 2010 |
|---|---|---|---|---|---|---|---|---|---|
| Architectural Coating Sales, Solvent | | 1.00 | 1.00 | 1.00 | 1.01 | 1.03 | 1.04 | 1.06 | 1.12 |
| Architectural Coating Sales, Water-base | | 1.00 | 1.06 | 1.09 | 1.12 | 1.14 | 1.18 | 1.17 | 1.24 |
| Agricultural | $ Output | 1.00 | 1.10 | 1.14 | 1.16 | 1.20 | 1.23 | 1.26 | 1.43 |
| Mining Ouput | $ Output | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Food Output | $ Output | 1.00 | 1.08 | 1.11 | 1.15 | 1.18 | 1.20 | 1.23 | 1.39 |
| Manufacturing | $ Output | 1.00 | 1.12 | 1.18 | 1.26 | 1.34 | 1.40 | 1.44 | 1.63 |
| Furniture Mfg | $ Output | 1.00 | .99 | 1.05 | 1.11 | 1.20 | 1.25 | 1.28 | 1.44 |
| Rail Transportation | $ Output | 1.00 | 1.02 | 1.05 | 1.08 | 1.11 | 1.14 | 1.15 | 1.24 |
| Construction | $ Output | 1.00 | 1.05 | 1.11 | 1.16 | 1.21 | 1.25 | 1.28 | 1.44 |
| Aerosol Product Sales | | 1.00 | 1.04 | 1.07 | 1.10 | 1.12 | 1.14 | 1.17 | 1.25 |
| Agriculture & Mining Employment | | 1.00 | .99 | .97 | .96 | .94 | .91 | .89 | .75 |
| Construction Employment | | 1.00 | 1.09 | 1.15 | 1.21 | 1.26 | 1.30 | 1.35 | 1.55 |
| Manufacturing Employment | | 1.00 | 1.02 | 1.07 | 1.11 | 1.16 | 1.20 | 1.24 | 1.40 |
| Transp, Comm, Util Employment | | 1.00 | 1.06 | 1.11 | 1.16 | 1.20 | 1.24 | 1.27 | 1.40 |
| Wholesale Trade Employment | | 1.00 | 1.7 | 1.13 | 1.19 | 1.25 | 1.30 | 1.36 | 1.70 |
| Retail Trade Employment | | 1.00 | 1.09 | 1.15 | 1.21 | 1.26 | 1.30 | 1.35 | 1.54 |
| Finance, Insurance, Real Estate Employ | | 1.00 | 1.05 | 1.10 | 1.15 | 1.19 | 1.23 | 1.26 | 1.43 |
| Services Employment | | 1.00 | 1.10 | 1.15 | 1.20 | 1.25 | 1.30 | 1.34 | 1.54 |
| Government Employment | | 1.00 | 1.01 | 1.01 | 1.01 | 1.02 | 1.02 | 1.02 | 1.01 |
| Population | | 1.00 | 1.04 | 1.07 | 1.09 | 1.11 | 1.13 | 1.15 | 1.23 |
| Households | | 1.00 | 1.05 | 1.08 | 1.11 | 1.14 | 1.16 | 1.19 | 1.29 |
| Employed Residents | | 1.00 | 1.06 | 1.10 | 1.13 | 1.16 | 1.19 | 1.22 | 1.29 |
| Mean Household Income | | 1.00 | 1.04 | 1.07 | 1.09 | 1.12 | 1.14 | 1.17 | 1.29 |

## TABLE XII. MOTOR VEHICLE GROWTH FACTORS FOR THE YEAR 2000

| Vehicle Class | Alameda | Contra Costa | Marin | Napa | San Franciso | San Mateo | Santa Clara | Solano | Sonoma |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Light Duty Autos | | | | |
| Catalytic | | | | | | | | | |
| VMT | 1.447 | 1.579 | 1.461 | 1.555 | 1.275 | 1.391 | 1.495 | 1.702 | 1.655 |
| Trip | 1.220 | 1.443 | 1.404 | 1.369 | 1.095 | 1.390 | 1.501 | 1.482 | 1.575 |
| Vehicle | 1.315 | 1.557 | 1.514 | 1.476 | 1.181 | 1.499 | 1.618 | 1.598 | 1.699 |
| Non-catalytic | | | | | | | | | |
| VMT | .010 | .011 | .010 | .011 | .009 | .009 | .010 | .011 | .012 |
| Trip | .008 | .010 | .010 | .009 | .007 | .009 | .010 | .010 | .011 |
| Vehicle | .011 | .013 | .013 | .012 | .010 | .013 | .014 | .013 | .014 |
| Diesel | | | | | | | | | |
| VMT | .103 | .110 | .101 | .120 | .091 | .097 | .105 | .124 | .118 |
| Trip | .086 | .102 | .099 | .097 | .077 | .098 | .106 | .105 | .111 |
| | | | | | Light & Medium Duty Trucks | | | | |
| Catalytic | | | | | | | | | |
| VMT | 1.656 | 1.698 | 1.624 | 1.753 | 1.645 | 1.537 | 1.534 | 1.828 | 1.723 |
| Trip | 1.397 | 1.553 | 1.561 | 1.544 | 1.413 | 1.535 | 1.539 | 1.590 | 1.639 |
| Vehicle | 1.559 | 1.734 | 1.744 | 1.720 | 1.578 | 1.715 | 1.719 | 1.774 | 1.826 |
| Non-catalytic | | | | | | | | | |
| VMT | .036 | .038 | .036 | .036 | .038 | .036 | .034 | .039 | .033 |
| Trip | .030 | .034 | .035 | .032 | .030 | .034 | .034 | .034 | .034 |
| Vehicle | .046 | .053 | .054 | .049 | .046 | .053 | .053 | .052 | .053 |
| Diesel | | | | | | | | | |
| VMT | .120 | .125 | .129 | .125 | .132 | .117 | .114 | .147 | .128 |
| Trip | .103 | .114 | .115 | .114 | .106 | .114 | .113 | .117 | .120 |
| | | | | | Heavy Duty Trucks | | | | |
| Catalytic | | | | | | | | | |
| VMT | 24.00 | 26.20 | 23.00 | 22.00 | 20.70 | 23.54 | 23.89 | 27.80 | 24.50 |
| Trip | 20.63 | 23.23 | 23.09 | 23.01 | 20.26 | 22.76 | 23.31 | 23.88 | 24.80 |
| Vehicle | 30.10 | 33.94 | 33.68 | 33.48 | 29.58 | 33.23 | 34.04 | 34.89 | 36.12 |
| Non-catalytic | | | | | | | | | |
| VMT | .271 | .291 | .272 | .286 | .243 | .256 | .270 | .309 | .295 |
| Trip | .233 | .262 | .261 | .260 | .228 | .257 | .263 | .269 | .280 |
| Vehicle | .362 | .408 | .406 | .405 | .356 | .400 | .410 | .420 | .436 |
| Diesel | | | | | | | | | |
| VMT | 1.339 | 1.418 | 1.320 | 1.390 | 1.267 | 1.272 | 1.330 | 1.500 | 1.439 |
| | | | | | Motorcyles | | | | |
| Non-catalytic | | | | | | | | | |
| VMT | 1.309 | 1.322 | 1.359 | 1.368 | 1.133 | 1.222 | 1.357 | 1.629 | 1.531 |
| Trip | 1.311 | 1.326 | 1.351 | 1.354 | 1.139 | 1.225 | 1.359 | 1.616 | 1.543 |
| Vehicle | 1.311 | 1.326 | 1.351 | 1.353 | 1.139 | 1.225 | 1.359 | 1.616 | 1.543 |
| | | | | | Urban Buses | | | | |
| Diesel | | | | | | | | | |
| VMT | 1.112 | 1.200 | 1.167 | 1.000 | 1.059 | 1.100 | 1.111 | 1.333 | 1.286 |

* Growth factor for catalytic HD trucks is large because the base year (1987) population was very small; 1987 was the first year of catalyst use on HDT.

Total baseline emissions of pollutants and the relative contributions by stationary and mobile sources are shown in Figures 1 through 5. The total emissions of ROG, $NO_x$ and CO decrease from the years 1987 to 2000 as follows: ROG (-17%), $NO_x$ (-17%) and CO (-32%). The $SO_2$ emissions remain practically the same and the particulate emissions increase by 26%.

Relative contributions to emissions of ROG, $NO_x$, CO and PM by area, point, on-road mobile and other mobile sources for the years 1987, 1994, 1997, 2000 and 2010 are shown in Figures 6-10. The figures show that relative contributions of ROG, $NO_x$, and CO emissions by mobile sources are declining over the years. Mobile sources contribute most of the NOx emissions: 73% in 1987 and 63% 2010. Almost all CO emissions are produced by mobile sources; 91% in 1987 and 78% in 2010. Most of the PM emissions are from road dust and construction activities.

ROG Emissions

The most significant decrease in ROG emissions between the years 1987 and 2000 is from light duty autos and trucks (1987: 278 tons/day; 2000: 122 tons/day). Lower emissions are attributed to the introduction of newer vehicles that comply with increasingly stringent exhaust and evaporative emission standards, already adopted to cover future years. In 1987 about 20% of the light duty autos in use were not equipped with catalytic converters. By the years 2000, however, essentially all light duty autos on the roads will have catalytic convertors. The baseline emission factor for the year 2010 includes a non-methane hydrocarbon emission standard, adopted in 1989, of 0.25 grams/mile for Light Duty Autos (LDA) and Light Duty Trucks (LDT's). This is significantly more stringent than the current standard of 0.39 grams per mile. A phase-in schedule for new vehicles that comply with the 0.25 grams/mile begins in 1993 and will be completed by 1997, when all the new LDAs must meet the standard. Emission reductions are also expected to decline due to the implementation of the improved Inspection and Maintenance Program ("Smog Check").

$NO_x$ Emissions

$NO_x$ emissions from motor vehicles (1987: 343 tons/day; 2000: 214 tons/day) decrease substantially due to the replacement of LDA-Non cats with LDA-cats and implementation of $NO_x$ exhaust emission standard of 0.4 grams/mile; replacing the present standard of 0.7 grams/mile. Between the years 2000 and 2010, $NO_x$ emissions from mobile sources increase slightyly, reflecting an increase in projected vehicle miles traveled (VMT) due to increasing population.

CO Emissions

Almost 90% of CO emissions are produced by motor vehicles. Between 1987 and 2010, CO emissions from motor vehicles decrease significantly, leading to a large net decrease in CO emissions in the region. As with $NO_x$ emissions, reduction in CO emissions from motor vehicles reflect more stringent exhaust standards and the use of catalytic convertors. In 1993 at least 40% of passenger cars and light duty trucks must comply with a certification exhaust standard of 3.4 grams/mile, half of the current standard of 7.0 grams/mile. By 1997 all passenger cars must comply with the 3.4 grams/mile exhaust standard.

## ROG Emission Trend

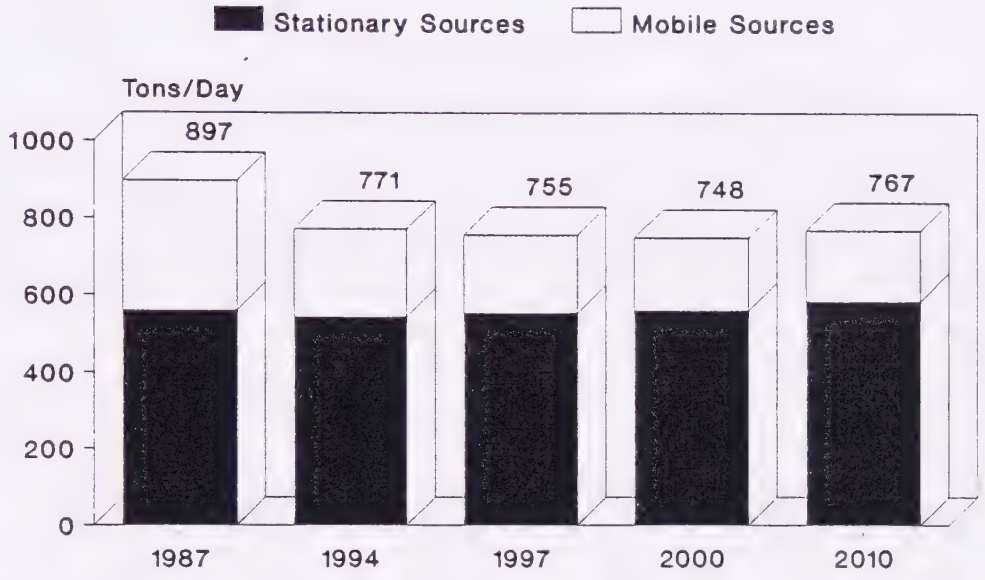


Figure 1

## NOx Emission Trend

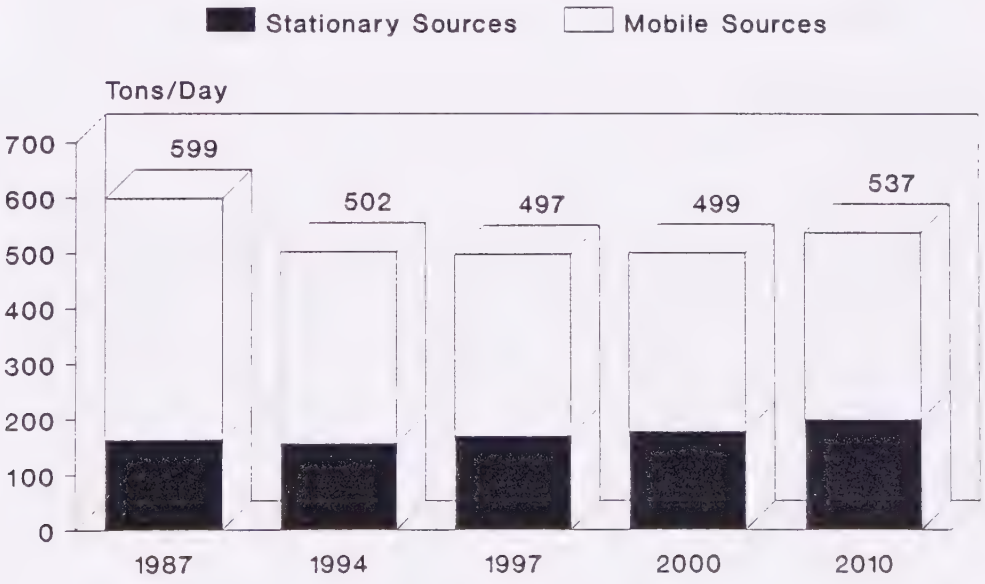


Figure 2

## CO Emission Trend

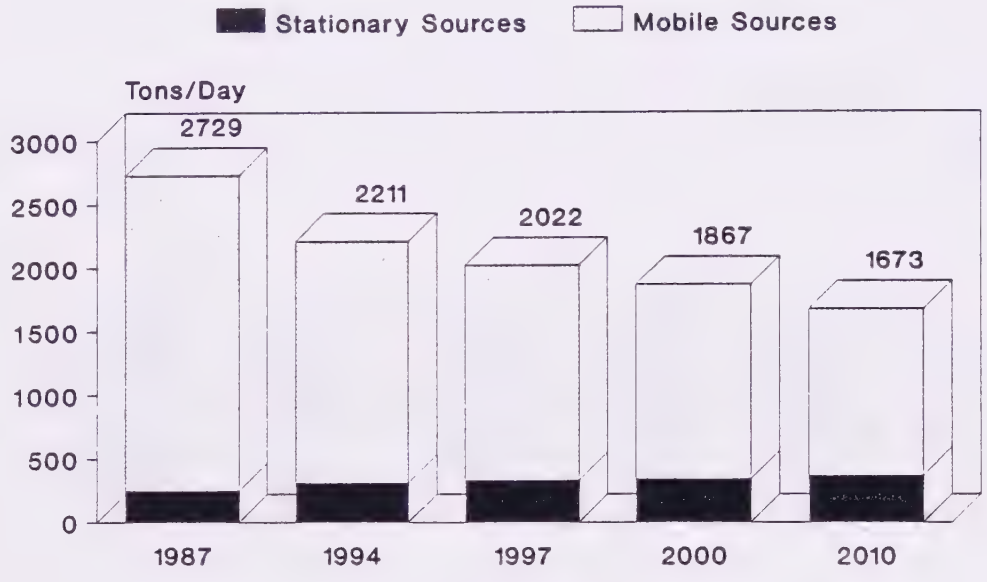


Figure 3

## PM Emission Trend

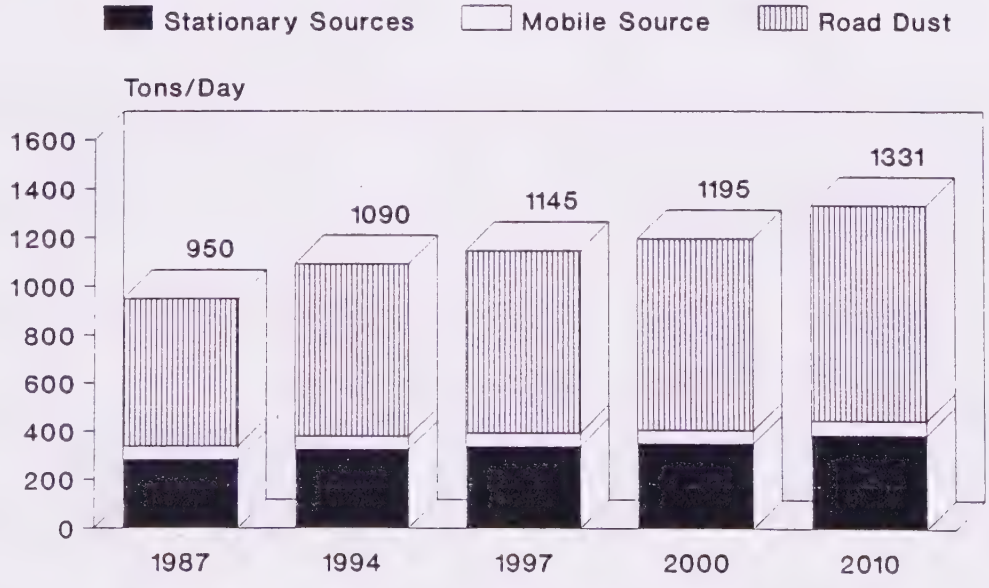


Figure 4

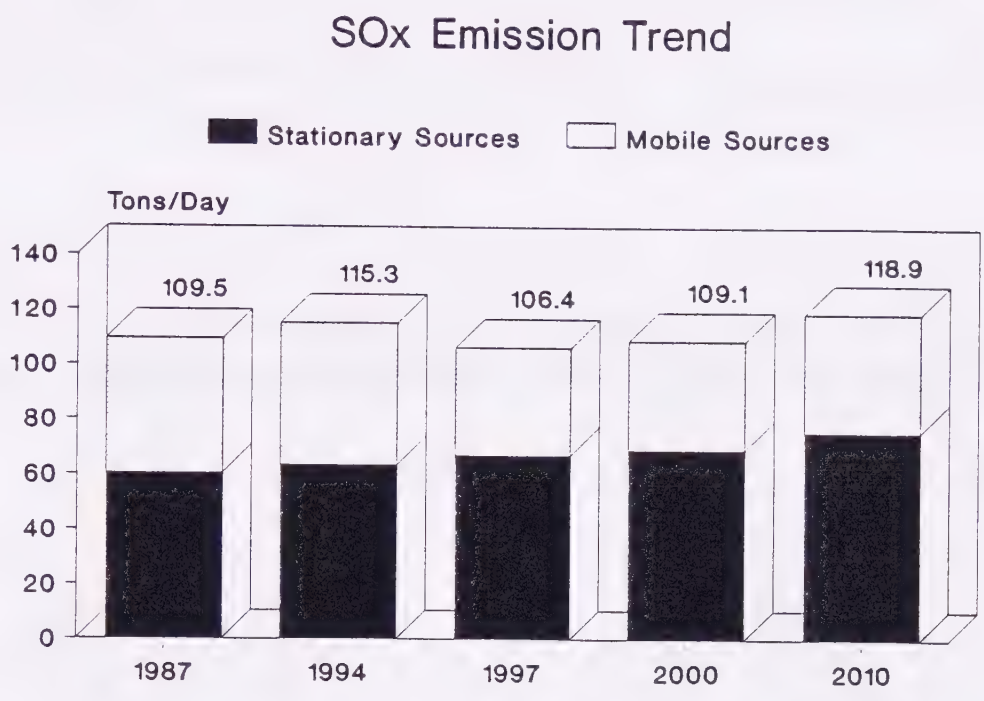
SOx Emission Trend
Stationary Sources
Mobile Sources
Tons/Day
140
120
100
80
60
40
20
0
109.5
115.3
106.4
109.1
118.9
1987
1994
1997
2000
2010

Figure 5

# Contribution of 1987 Emissions By Source Category-Average Day

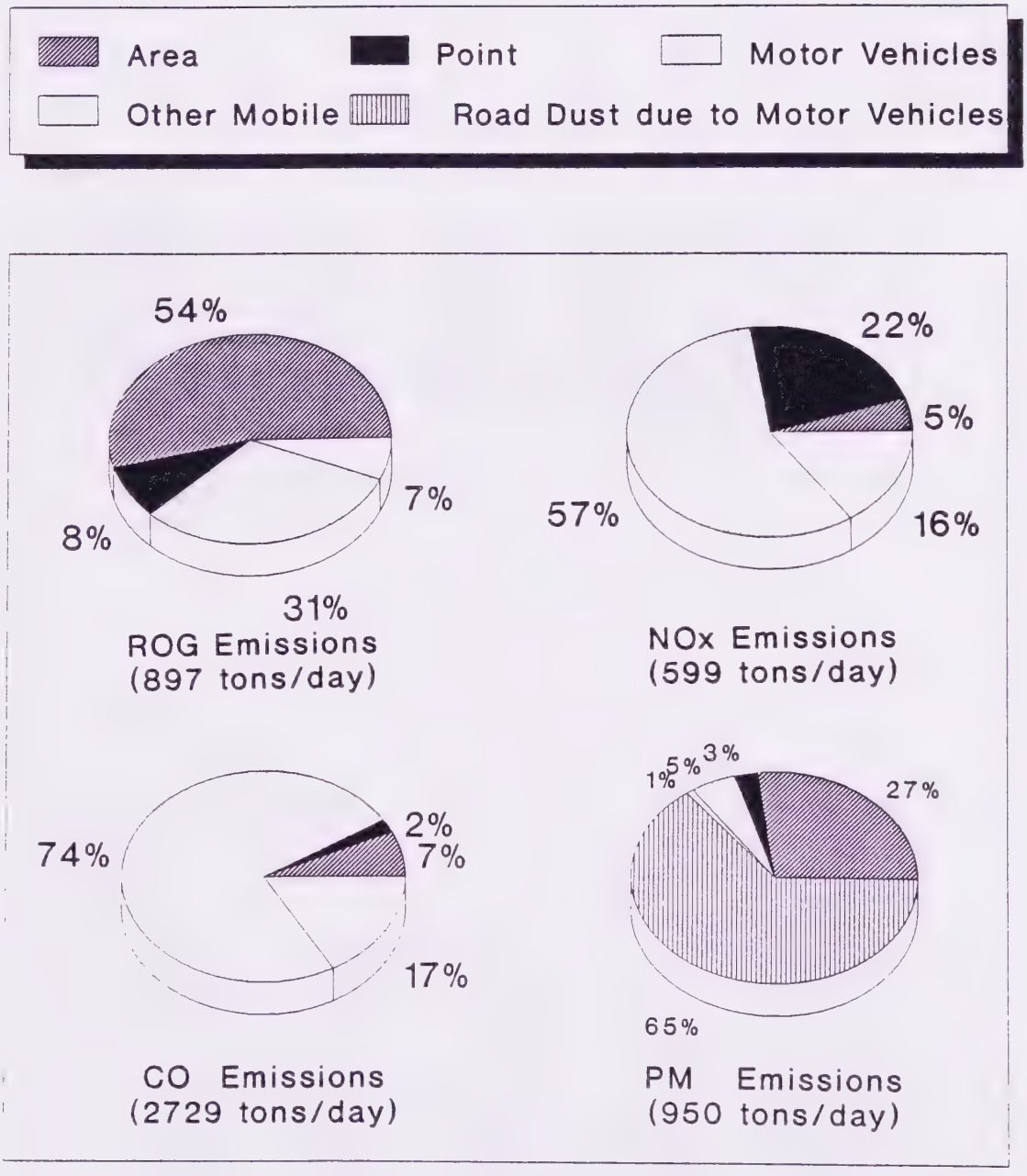


Figure 6

# Contribution of 1994 Emissions By Source Category-Average Day

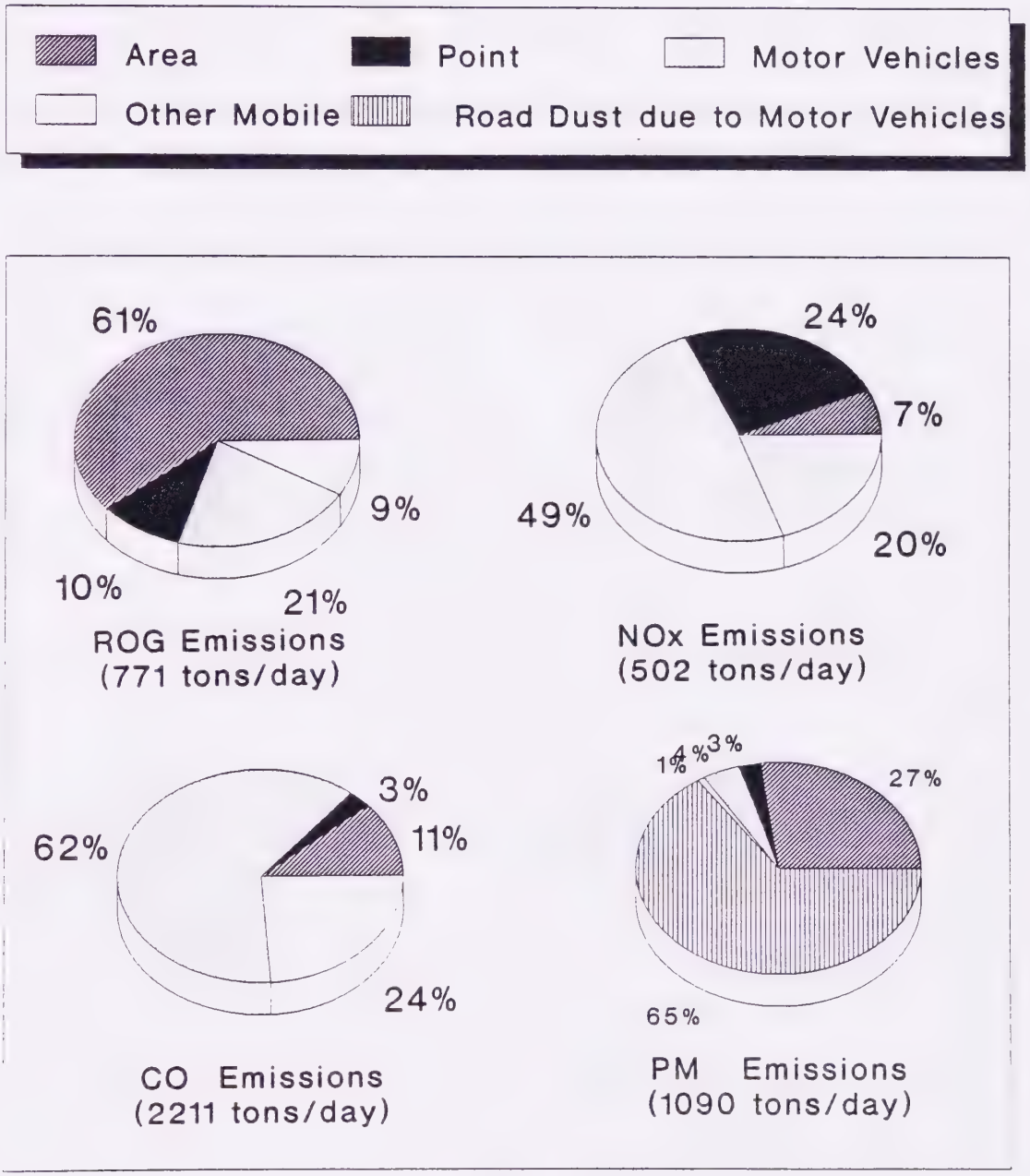


Figure 7

# Contribution of 1997 Emissions By Source Category-Average Day

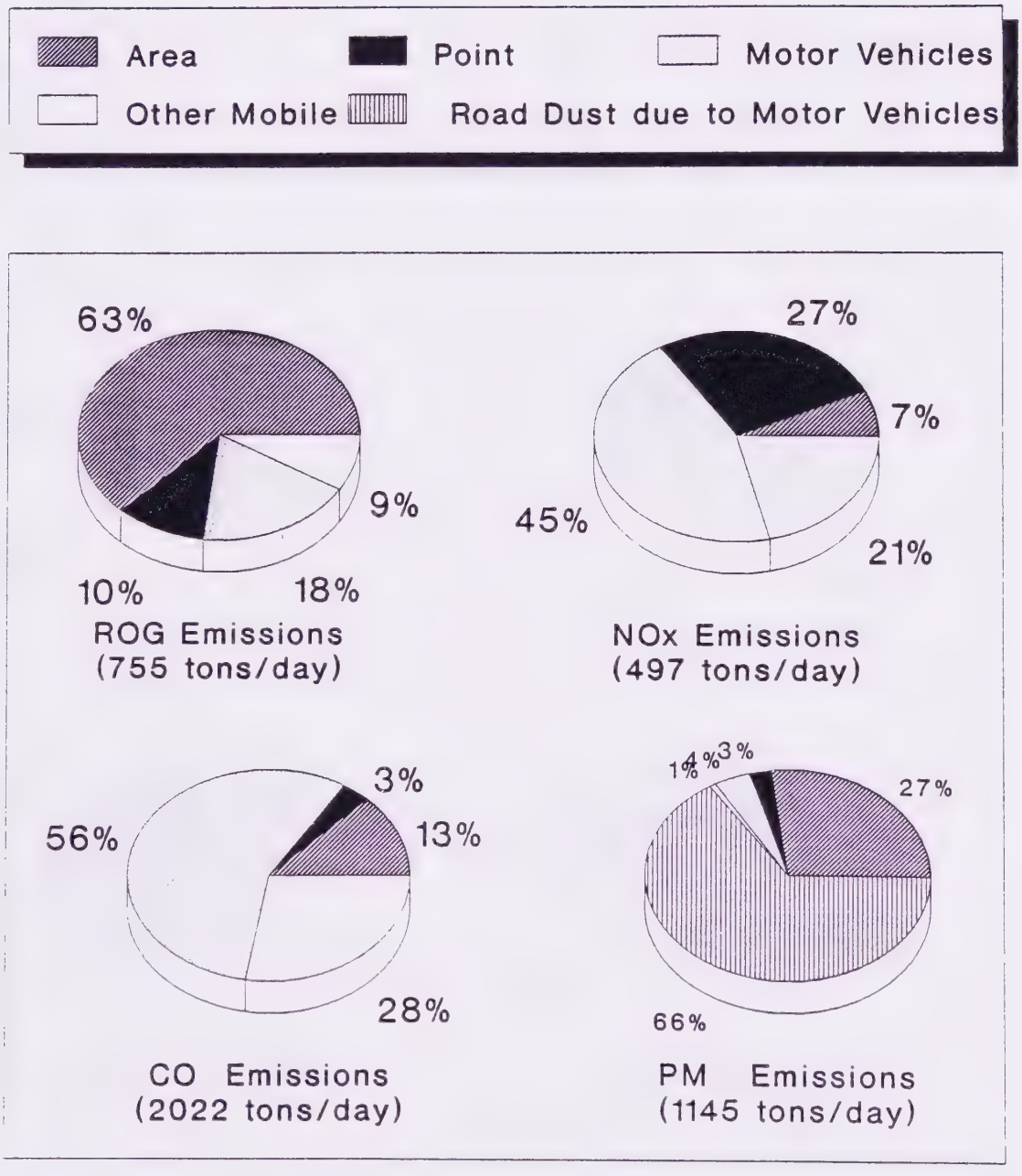


Figure 8

# Contribution of 2000 Emissions By Source Category-Average Day

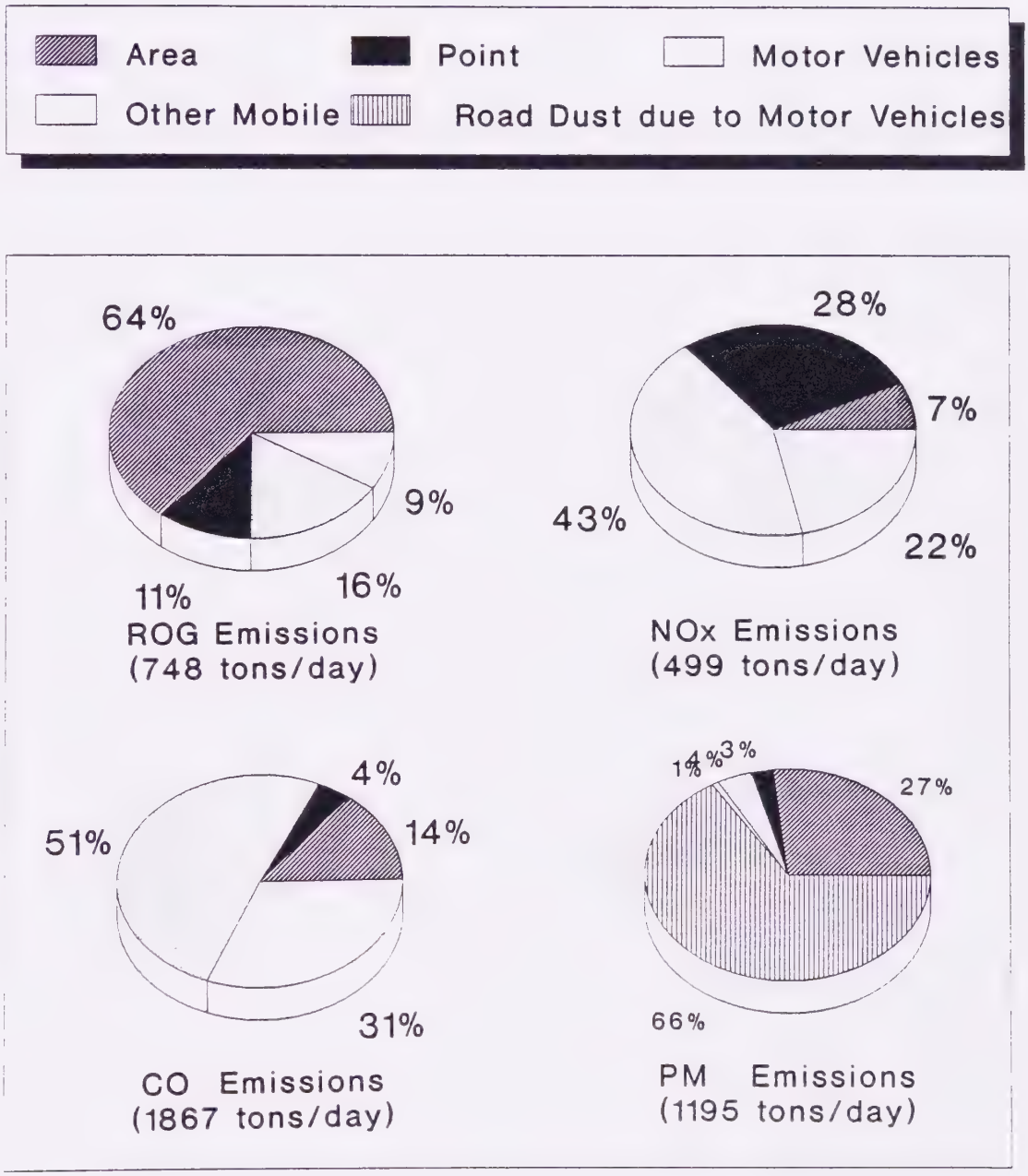


Figure 9

# Contribution of 2010 Emissions By Source Category-Average Day

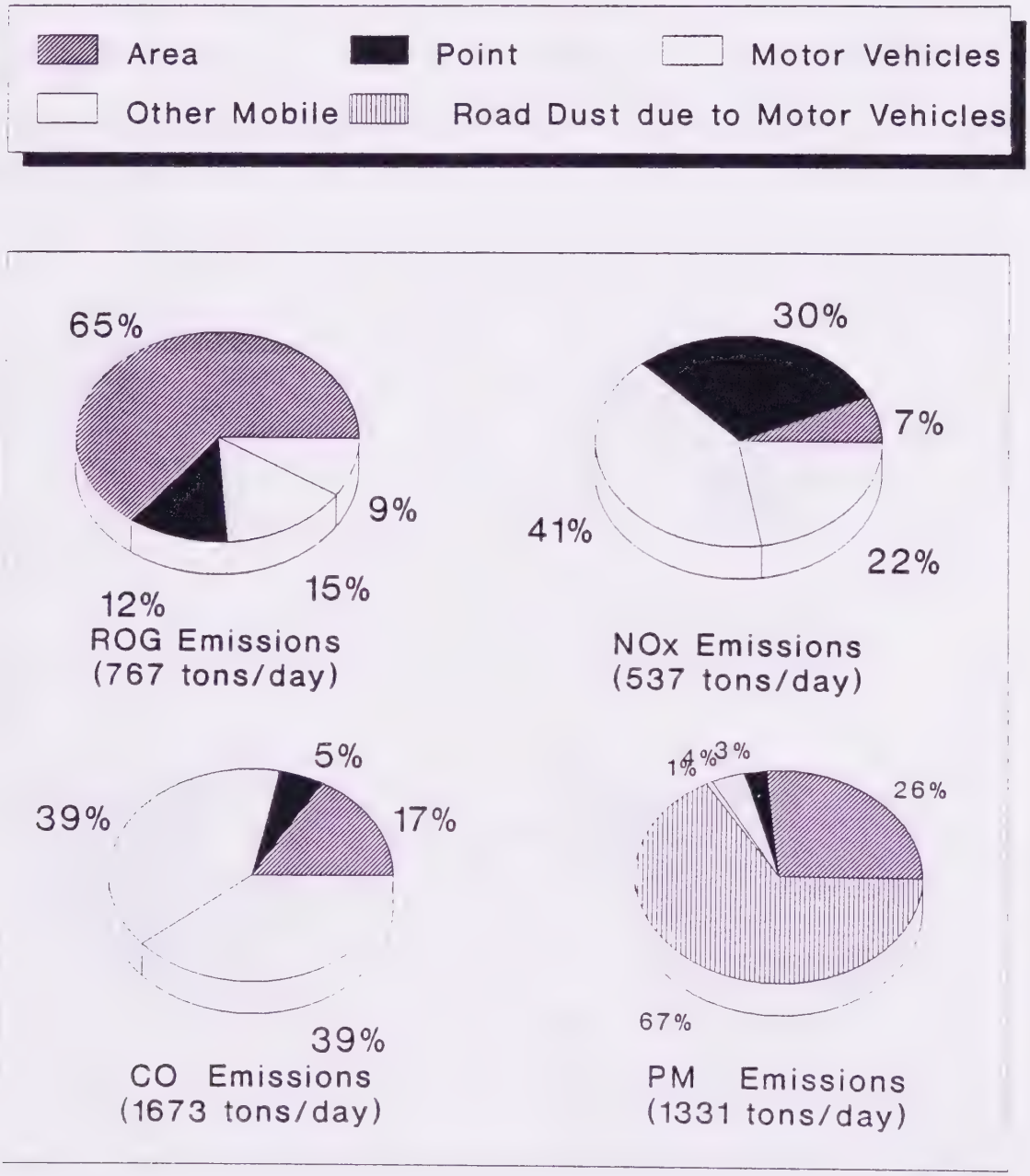


Figure 10

PM Emissions

Particulate emissions are predicted to increase significantly between 1987 and 2010 (41% from figure 4). This is due mostly to an increase in entrained road dust from 613 tons/day in 1987 to 886 tons/day by 2010. This increase in road dust parallels, and is caused by, an increase in vehicle miles traveled (+60%) resulting from a substantial rise in population (+31%). Local projections of population and VMT growth are significantly lower than the ARB projections cited above. An effort to reconcile the methodologies and results is underway.

## FUTURE CONTROL EFFECTS

All of the emission projections in this document represent baseline estimates, incorporating the effects of control programs already adopted at the time of inventory preparation. (Some of the already-adopted programs may have future-effective implementation schedules.)

New rules, regulations and programs developed from the '91 CAP and other related efforts will reduce emissions to levels below the baseline projections. The emission reductions expected from individual '91 CAP measures are shown in Section 5 of Volume I of the CAP.